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Location-Based Artificial Intelligence and Augmented Reality-Assisted Preventive Information Application

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ABSTRACT

This study describes the development of a location-based preventive information application supported by augmented reality and artificial intelligence. It can be very difficult to stay updated about the safety measures implemented for the settlement in our region while carrying out daily tasks. With this application created in this context, while obtaining preliminary information about our location, it will be incredibly simple for us to obtain information such as the level of measures taken for the location, the last inspection control dates of the existing equipment in the location, earthquake safety, etc. The application produced by combining augmented reality, artificial intelligence, and cloud computing technologies delivers data to us for this purpose. Individuals will be aware of the location as a result of the offered information, allowing them to act more safely. As a result, the developed application made it possible to reach all the data about the places in the applied locations and successful findings were obtained.

1. INTRODUCTION

Information regarding the location-based systems of the buildings in our residential area is becoming increasingly significant. Technology allowed us to extend our experiences beyond time and location with the development of smartphones into our lives. People have access to relevant, context-sensitive, and personalized information about their specific location and what they are doing wherever they are, and they can request information about services in the regions they are approaching [1]. Today, it appears conceivable to obtain and assess this information by fusing modern technologies like artificial intelligence (AI), edge computing, cloud computing, and augmented reality. Augmented Reality (AR) is a technology based on combining artificial images with real images in real time to give us more information about the real environment around us [2]. AI can be used to personalize offerings to improve learning [3]. Therefore, by developing a collaborative hybrid building architecture, it will be possible to have information and even a risk assessment of a building that we have not entered yet, along with our current location information, in real time.

Ivan Sutherland and his colleagues created a mechanically tracked 3D see-through head-worn display in 1968 [4]. Loomis and his colleagues from the University of California, Santa Barbara, developed a GPS-based outdoor system in 1993 that provided visually impaired people with navigational help using spatial audio overlays [5]. Julie Martin created the first augmented reality theater play in 1994, which included virtual objects on the physical stage and acrobats dancing within [6].

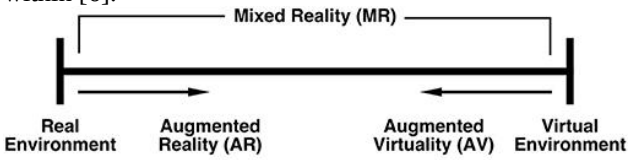

Fig. 1 Reality-Virtuality Continuum [7]

Milgram et al. explain the relationship between virtual and real environments in Figure 1 [7]. There, an integration of physical and digital environments could be noticed.
Mobile Augmented Reality creates more and more material with geographic information without actual limitations, offering a sensitive environment in a virtual world which satisfies the requirements. [8]. Many industries, such as library administration, can benefit from mobile augmented reality applications. [9]. The field of cultural heritage has seen numerous adaptations of it [10].

Data from multiple sources is gathered and sanitized to ensure homogeneity in machine learning. The model is developed using the best machine learning algorithm. The results provide insight, and the data is visualized. Sequence the steps of Artificial Intelligence (AI): reasoning (deductive, inductive, abductive, common sense, monotonic, non-

monotonic), semantic context (data quality, findability, productivity, insight, better customer experience), knowledge mapping, language, perception, narrow AI, general AI, strong AI. Some applications of artificial intelligence include virtual personal assistants, climate, finance, agriculture, education, logistics and transportation, business, and health [11].

Edge computing is a new paradigm that is expected to have the same impact as cloud computing. The term "edge" refers to resources and equipment positioned between data sources and cloud data centers, particularly near terminal devices. Applications are supplied as a service through the Internet in cloud computing [12].

The development of sensor-based systems is gaining attraction. Furthermore, a wide range of technologies based on these methodologies can be employed in conjunction with wireless networks, image-based techniques, activity detection, accelerometers, and gyroscopes. Education in a virtual world can provide a safe atmosphere for skill development without endangering anyone's safety [13].

Preventive information by GEMET is defined as “data communicated or received concerning the recommended means of averting risk of an accident, disaster or other undesirable and avoidable incident” [14].

Big data, which is anticipated to be needed, needs analysis and forecasting. In order to assist precise location and well-informed decision-making for structures placed in settlements, this study will give visualization of multi-source static and dynamic data based on AI and AR technology. In order to demonstrate the viability of applying preventive information, a prototype of software supported by augmented reality and artificial intelligence has been created. Two case studies were conducted to validate the implementation. Chapter 2 presents related works in the literature. Chapter 3 includes the methodology of the study. In Chapter 4, the results of the application are discussed. The study continues with the results and future studies.

2. RELATED WORKS

The literature's relevant studies are presented in this section.

Augmented reality technology is used in the construction of a mobile environmental monitoring system to promote more efficient monitoring and management techniques [15].

A data-gathering application for geoscientists driven by mobile augmented reality was created by Gazcon et al. as a supplement to their fieldwork without the use of the Internet [16].

A hybrid application powered by augmented reality and artificial intelligence was created by Sabeti et al. to ensure the safety of workers in highway areas [17].

El Ammari and Hammad (2019) implied a data gathering and data entry facilitation system based on mixed reality and building information modeling to address the difficulties of interactive collaboration. Real-time sharing with the remote office and remote visual collaboration of field employees were given by capturing location-based building element data [18].

Using virtual reality (VR) technology, Lee et al. (2019) developed a data structure for risk management with historical building information modeling. They demonstrated that risk management information obtained through VR applications is faster and more trustworthy than information obtained through paper-based applications [19].

Ajslev& Nimb (2022) focused on identifying research trends, topics, and current research status in virtual design and construction for occupational health and safety purposes and, against this background, identifying gaps in research and practice. The results of this review indicate that there are important themes that need to be addressed for both researchers, industrial organizations and trade unions [13].

Indoor positioning systems and technologies evaluated and described in details for indoor navigation system. Developed system not needed to use map and data presented in the screen with the help of AR [20].

In a digital image, it is possible to determine the architecture with the help of mathematical equations and display new icons on it [21].

Building information modeling (BIM), a widely acknowledged method of boosting digitization, is a digital representation of a building's structural and functional characteristics that is used in planning, designing, constructing, and managing a building's lifecycle. Platforms for BIM and AR can be rated based on their fundamental capabilities [22].

In occupational safety and health training, augmented reality is a technology that is also applied, and the results are excellent for learning [23].

3. METHODOLOGY

This research focuses on the implementation of a preventive information system that makes use of location-based, artificial intelligence, and augmented reality technologies. The data in this case can be split into two groups: manually and automatically created data. In order to manually define the entry of the location's data into the database by the system user, then can define the image processing techniques and the transfer of the recorded data in the public information system as autonomous.

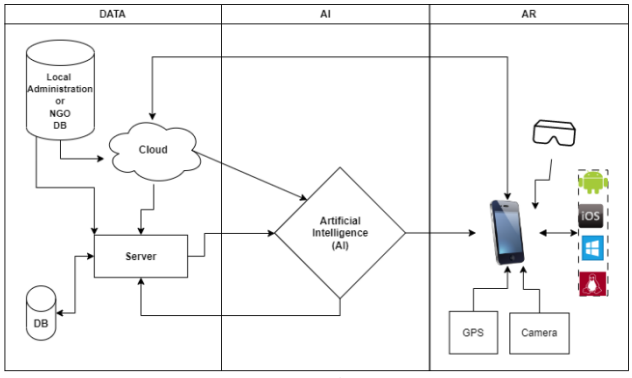

Fig 2 Layers of application

Figure 2 illustrates the application's layers. The increased requirement layer is the top layer of the system, which was designed as three layers. The program created for the layer of augmented reality communicates the data it gathers from a smartphone's GPS and camera. The data layer is the following layer. Information is accessed in the data layer via cloud computing technology. Data can be stored on dedicated servers and in local government databases. The third layer is

the artificial intelligence layer. In this layer, available data is processed using artificial intelligence algorithms. The developed cloud database's data layer can be mapped to four different sorts of functional components that are suggested for use in the Unity engine: (1) Components for the dynamic generation of 3D models from geometric, attribute, and coordinate location data; (2) Components for monitoring and inspection for mapping sensor and damage data; (3) Components for O&M support with verification information linked to due care data; and (4) Components for field record.

4. RESULTS & DISCUSSION

Accurate and directional information is crucial in today's environment. This study provides further knowledge and recommendations, such as the validity and reliability of this information, in addition to providing information about the structure experienced in practice.

The main objective here is to process data based on location information and generate actual outcomes through visualization.

TABLE I
DECISION PROCESSES

	Building Safety Precautions		Advice	Result
Location	Local	Personal		
A	4	4	Secure	Secure
B	3	2	Attention	Attention

The two chosen sites' decision-making procedures are displayed in Table 1 as case studies. Here, local and individual assessments of building security measures are made. Artificial intelligence helps and offers advice by creating the right culture with this data. The sample location image of the android-based application developed for Location-Based Artificial Intelligence and Augmented Reality-Assisted Preventive Information Application (PIA AR) is shown in Figure 3.

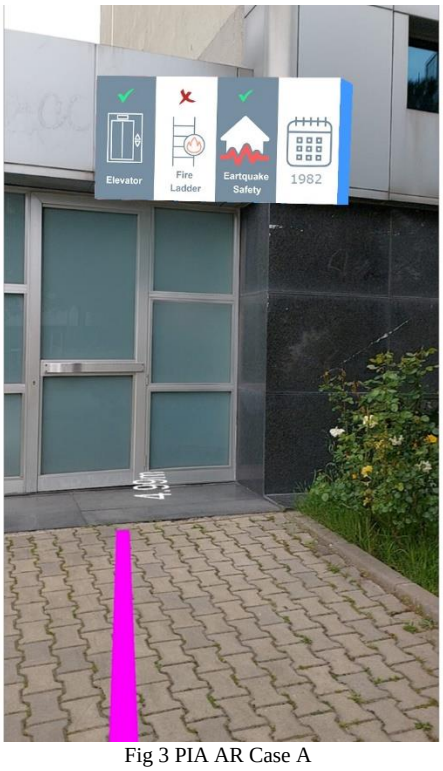

Fig 3 PIA AR Case A

Information on the distance to the location, the elevator, the fire escape, the building's ability to withstand an earthquake, and the year of construction are all provided here. Data from the local government database and user data are visualized using artificial intelligence techniques to provide elevator information. The same manner of visualizing is used to convey information about earthquake protection and whether a fire escape is there. Using artificial intelligence, it provides feedback on the next scene on the screen and recommends whether the area will be secure.

Fig 4 PIA AR Case B

Figure 4 displays a screenshot screen image from the PIA AR application at a different settlement position. Your distance to the settlement, as well as the fire escape, earthquake reliability, and building year information, are all visualized here. The elevator in the prior scenario is unavailable because it is not located in the building.

Comparing the two cases, that is feasible to conclude that the application will be successful in conveying preventive information and that the guidance provided before entering the settlement area will be a lifesaver in the event of potential disasters.

5. CONCLUSIONS

This study demonstrates a location-based, artificial intelligence, and augmented reality-based preventive information system application. The application has a structure of three layers. Cloud computing technologies are used to transport data between layers. Today, visualizing will give us the confidence to convey reliable information about the place where we will spend our time, whether it is where we live or where we will visit. Instantaneous location-based data transmission will also enable us to take precautions before dangerous disasters.

The study's findings revealed that the program successfully conveyed the data to us by visualizing it, and that the artificial intelligence-based warning system was operational. The application could be enhanced in the future by include further features, as well as a voice warning system.

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REFERENCES

[1] Watson, R., Akselsen, S., Monod, E., & Pitt, L. (2004). The Open Tourism Consortium:: Laying The Foundations for the Future of Tourism. European Management Journal, 22(3), 315-326.

[2] Romão, T., Correia, N., Dias, E., Danado, J., Trabuco, A., Santos, C., ... & Nobre, E. (2004). ANTS—augmented environments. Computers & Graphics, 28(5), 625-633.

[3] Gracias, J. S., Parnell, G. S., Specking, E., Pohl, E. A., & Buchanan, R. (2023). Smart Cities—A Structured Literature Review. Smart Cities, 6(4), 1719-1743.

[4] Rolland, J. P., & Hua, H. (2005). Head-mounted display systems. Encyclopedia of optical engineering, 2, 1-14.

[5] Loomis, J. M., Golledge, R. G., & Klatzky, R. L. (1998). Navigation system for the blind: Auditory display modes and guidance. Presence, 7(2), 193-203.

[6] Kim, S. K., Kang, S. J., Choi, Y. J., Choi, M. H., & Hong, M. (2017). Augmented-Reality Survey: from Concept to Application. KSII Transactions on Internet & Information Systems, 11(2).

[7] Milgram, P., Takemura, H., Utsumi, A., and Kishino, F. (1994). Augmented reality: a class of displays on the reality-virtuality continuum. Proc. SPIE 2351, 282–292. doi: 10.1117/12.197321

[8] Kanade, P., & Prasad, J. P. (2021). Mobile and location based service using augmented reality: a review. European Journal of Electrical Engineering and Computer Science, 5(2), 13-18.

[9] Shatte, A., Holdsworth, J., & Lee, I. (2014). Mobile augmented reality based context-aware library management system. Expert systems with applications, 41(5), 2174-2185.

[10] Ramtohul, A., & Khedo, K. K. (2022). Location-based mobile augmented reality systems: a systematic review. Immersive Technology in Smart Cities: Augmented and Virtual Reality in IoT, 41-65.

[11] Aurelia, S. (2020). Heightening Satellite Image Display via Mobile Augmented Reality – A Cutting-Edge Planning Model. In: Hemanth, D. (eds) Artificial Intelligence Techniques for Satellite Image Analysis. Remote Sensing and Digital Image Processing, vol 24. Springer, Cham. https://doi.org/10.1007/978-3-030-24178-0_1

[12] Zhang, T., Li, Y., & Chen, C. P. (2021). Edge computing and its role in Industrial Internet: Methodologies, applications, and future directions. Information Sciences, 557, 34-65.

[13] Ajslev, J. Z. N., & Nimb, I. E. E. (2022). Virtual design and construction for occupational safety and health purposes–A review on current gaps and directions for research and practice. Safety science, 155, 105876.

[14] GEMET. (2023). Definition of Preventive Information. Retrieved January 10, 2023, from http://www.eionet.europa.eu/gemet/concept/12866

[15] Pierdicca, R., Frontoni, E., Zingaretti, P., Mancini, A., Malinverni, E. S., Tassetti, A. N., ... & Galli, A. (2016). Smart maintenance of riverbanks using a standard data layer and Augmented Reality. Computers & Geosciences, 95, 67-74.

[16] Gazcón, N. F., Nagel, J. M. T., Bjerg, E. A., & Castro, S. M. (2018). Fieldwork in Geosciences assisted by ARGeo: A mobile Augmented Reality system. Computers & Geosciences, 121, 30-38.

[17] Sabeti, S., Shoghli, O., Baharani, M., & Tabkhi, H. (2021). Toward AI-enabled augmented reality to enhance the safety of highway work zones: Feasibility, requirements, and challenges. Advanced Engineering Informatics, 50, 101429.

[18] El Ammari, K., & Hammad, A. (2019). Remote interactive collaboration in facilities management using BIM-based mixed reality. Automation in Construction, 107, 102940.

[19] Lee, J., Kim, J., Ahn, J., & Woo, W. (2019). Context-aware risk management for architectural heritage using historic building information modeling and virtual reality. Journal of Cultural Heritage, 38, 242-252.

[20] Koyun, A. & Cankaya, I.A. (2018). Implementation of a Beacon-Enabled Mobile Indoor Navigation System Using Augmented Reality. Tehnički vjesnik, 25 (4), 979-985. https://doi.org/10.17559/TV-20160428091101

[21] Djordjevic, D., Radojevic, M.D. & Popovic, N. (2021). On-photo Restitution and Management of an Angular Size-Illusion's Behaviour Experienced in Architectural/Urban Spaces. Tehnički vjesnik, 28 (5), 1681-1690. https://doi.org/10.17559/TV-20200514000758

[22] Amin, K., Mills, G., & Wilson, D. (2023). Key functions in BIM-based AR platforms. Automation in Construction, 150, 104816.

[23] Kamal, A. A., Junaini, S. N., Hashim, A. H., Sukor, F. S., & Said, M. F. (2021). The Enhancement of OSH Training with an Augmented Reality-Based App. International Journal of Online and Biomedical Engineering (iJOE), 17(13), pp. 120–134. https://doi.org/10.3991/ijoe.v17i13.24517

BIOGRAPHIE

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